XRS / LYNX SENSITIVITY STUDIES

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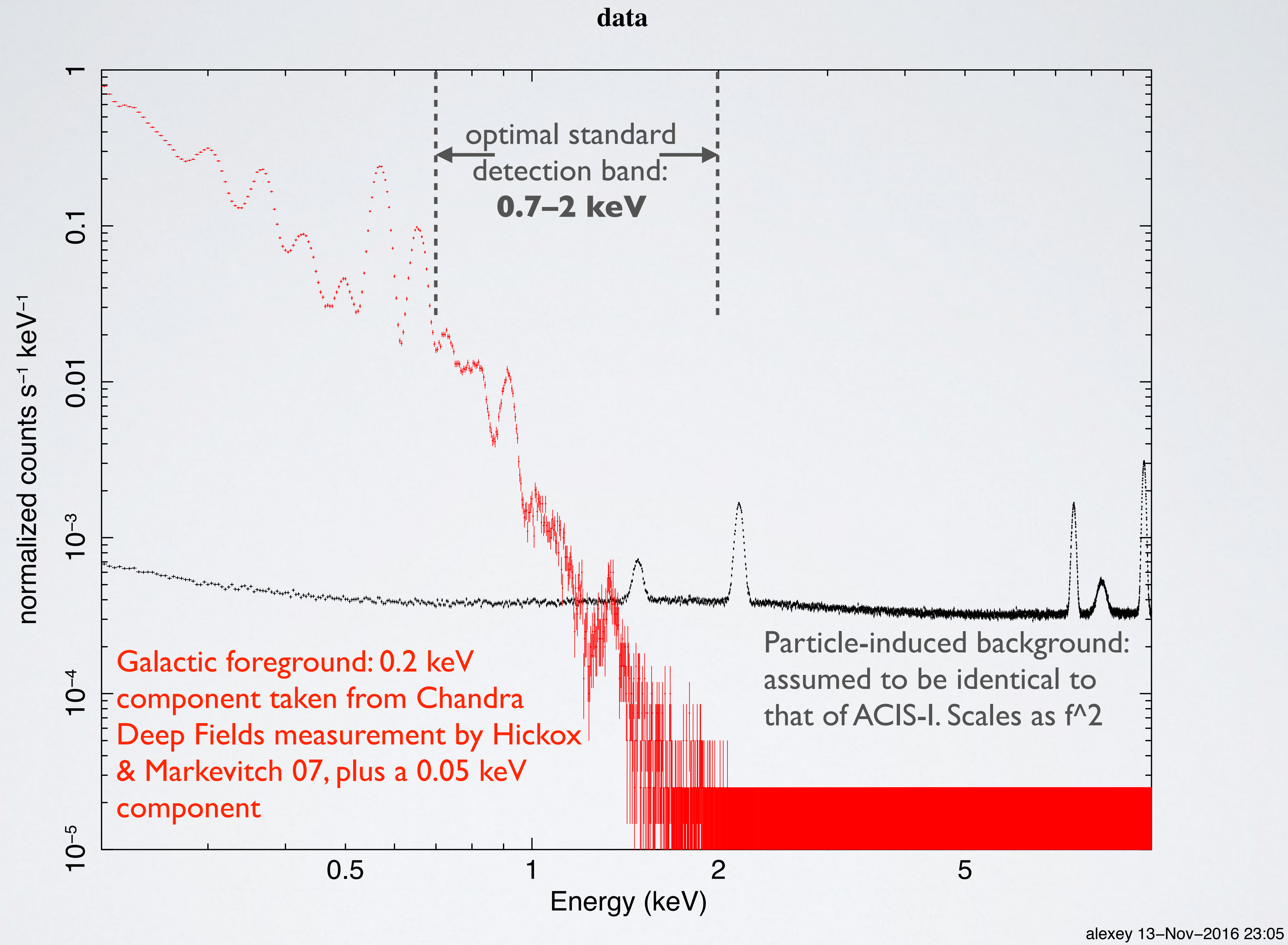
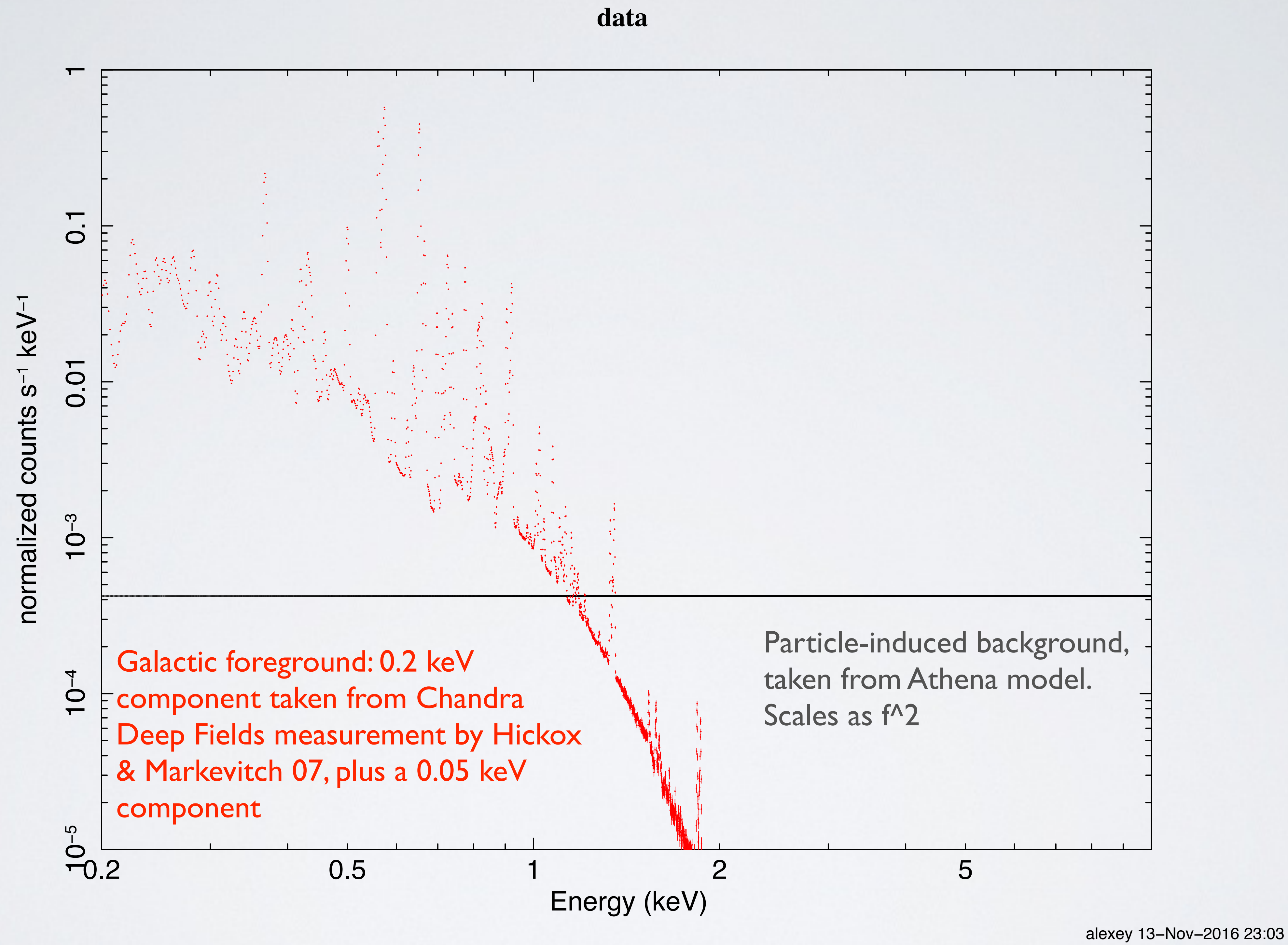
Context

- Response files are generated for four mirror configurations: d=3 and f=10, 15, and 20m, and d=6, f=20m. Referred to as 3x10, 3x15 etc. in what follows.
- Diffuse background models implemented
- Population of background point sources implemented using Lehmer et al. '12 results based on 4Msec CDFS. This component produces any unresolved CXB.
- Some improvements in point source detection implemented
- Study impact of observatory design choices on the point source sensitivity. Also started looking at the cluster detection.
- Have not studied off-axis sensitivies

Backgrounds: HDXI



Backgrounds: μCal



Source detection

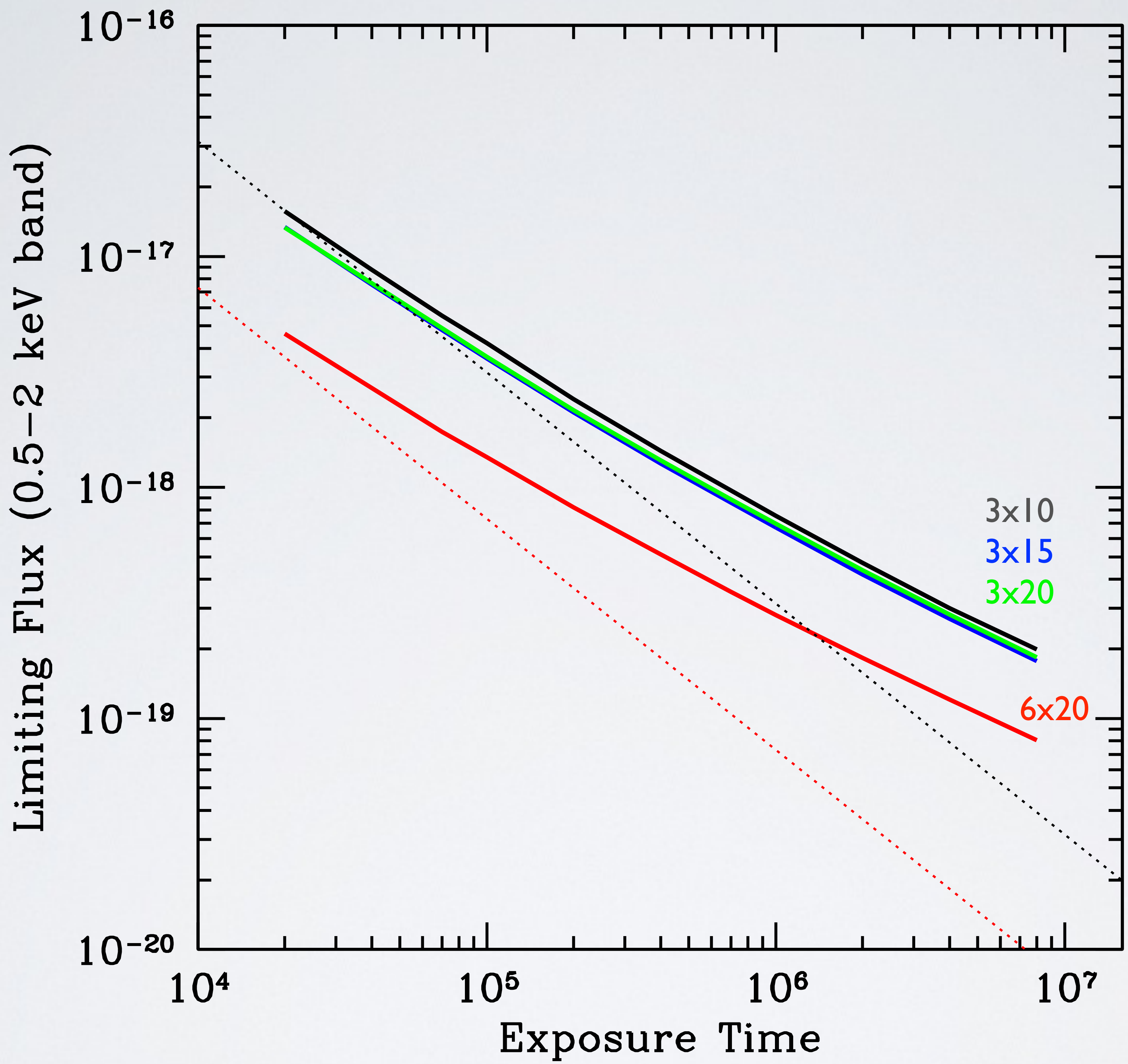
- Optimal filter (derived from max-likelihood considerations). Reduces false-positive rate by factors ~3 compared to convolution with the PSF. 15–20% improvement in detection limit.

- Additional improvements possible via optimal weighting of photons of different energies (currently not implemented).

- Results assume Gaussian mirror PSF with HPD=0.5 arcsec.

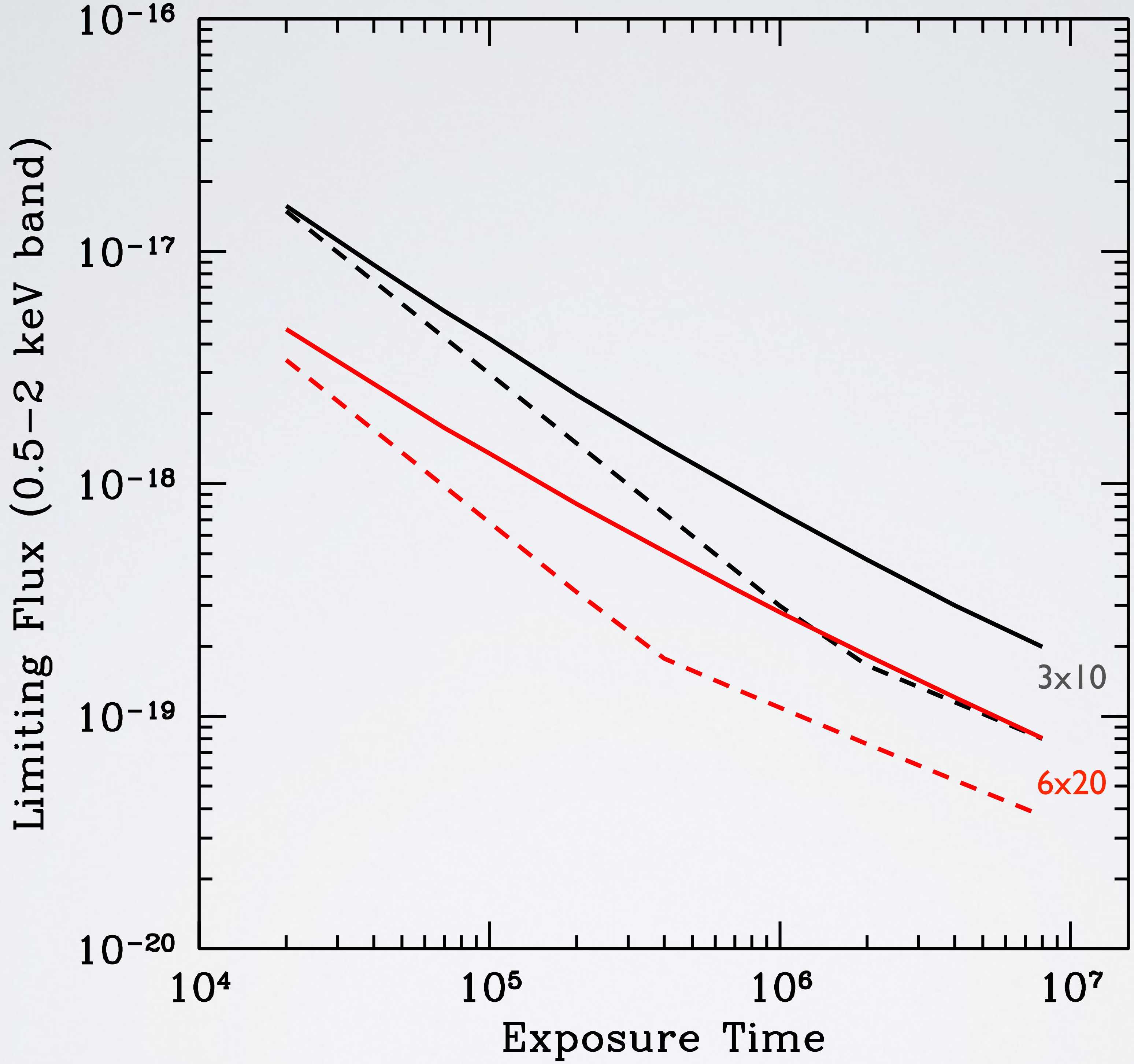
- Tried detector pixel sizes 0.11, 0.33, and 0.55 arcsec

Limiting flux as a function of exposure time



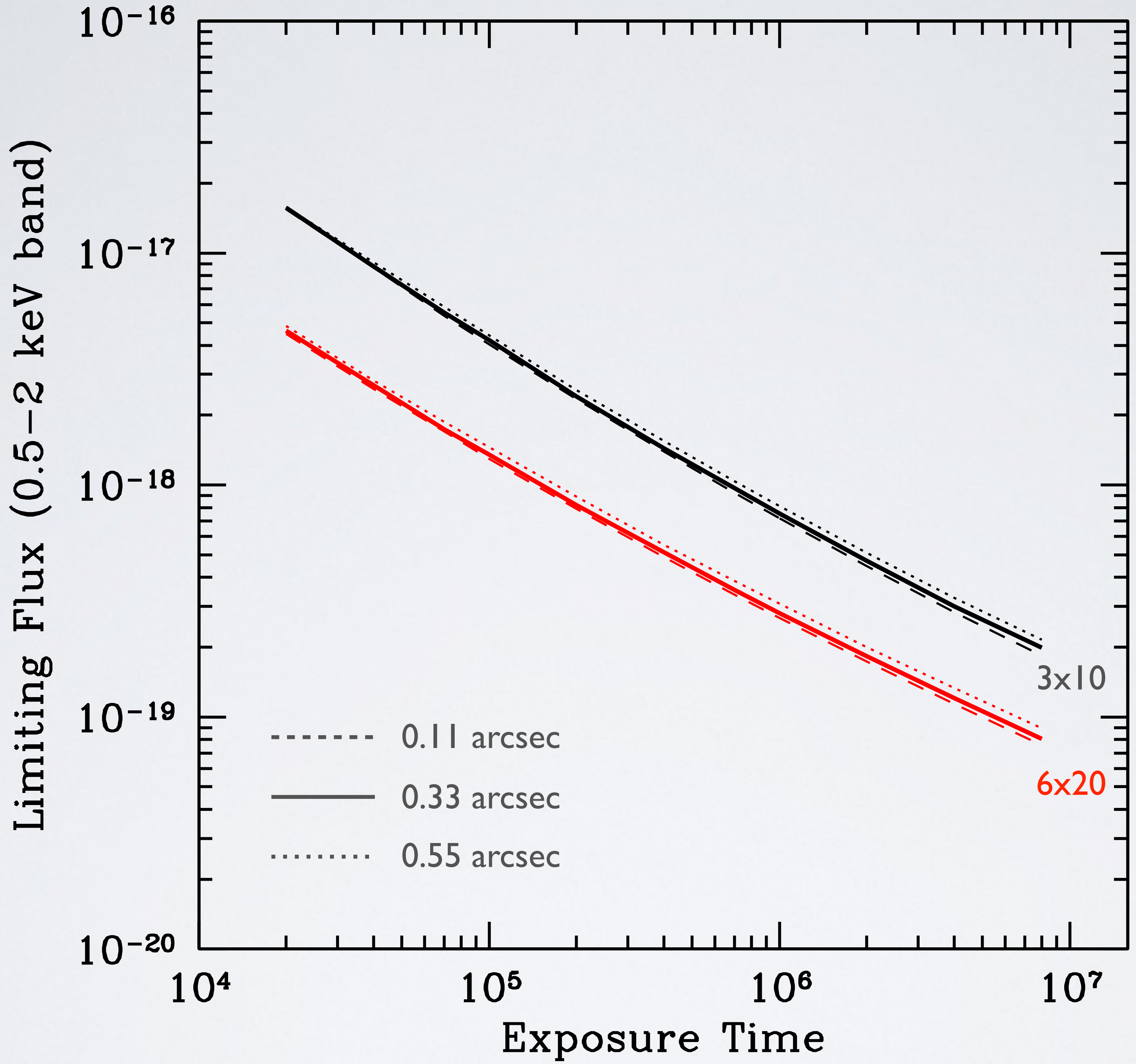
- Thresholds correspond to 1% false-positive rate relative to Lehmer'12 model

Blind detection vs. detection at known locations



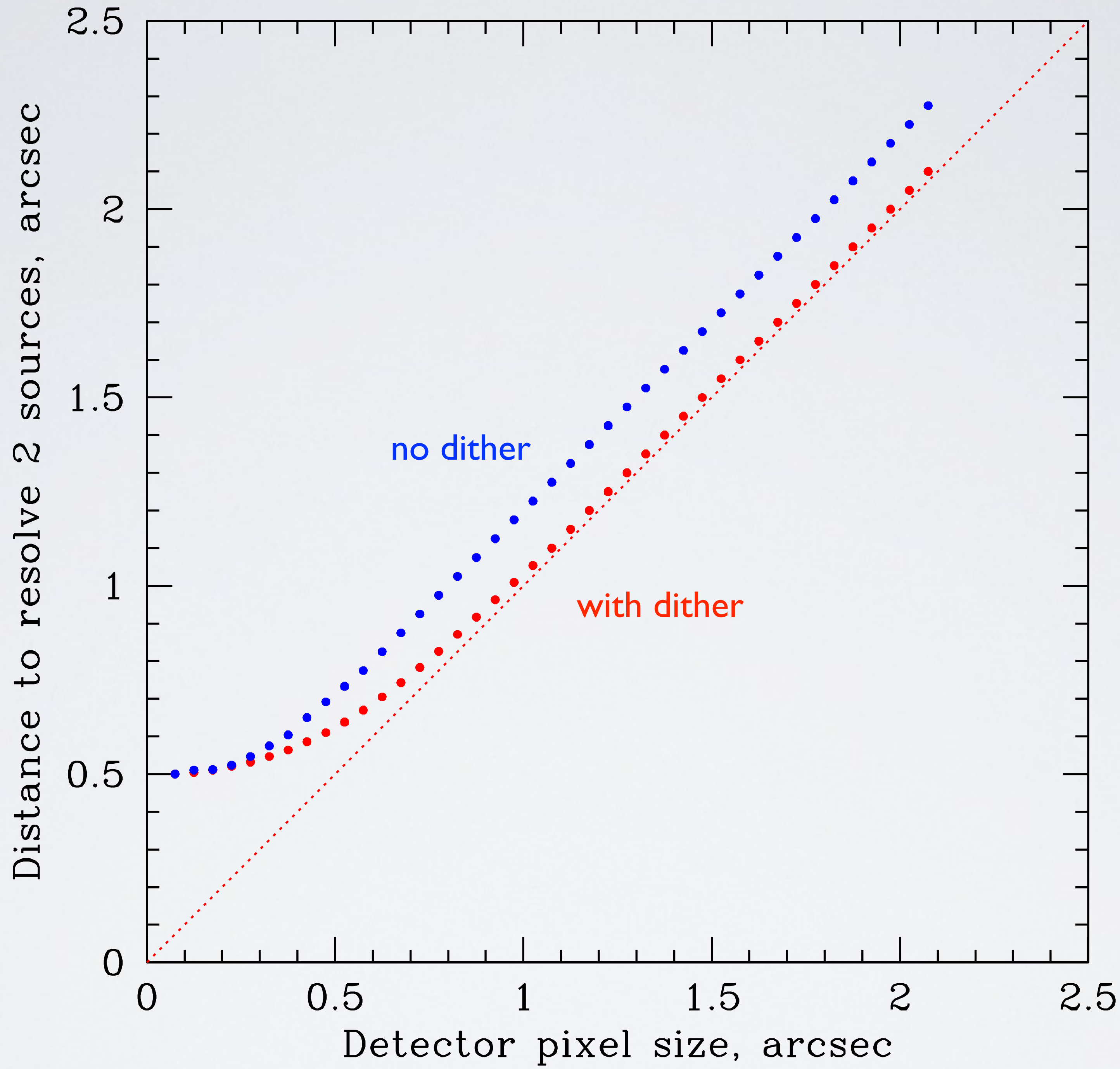
- Blinds thresholds correspond to 1% false-positive rate relative to Lehmer'12 model. Thresholds for "known" locations correspond to 5% probability of finding a false source within 0.5arcsec radius

Effect of detector pixel size on sensitivity



- 6% reduction in sensitivity going from 0.11 to 0.33 arcsec pixels, and a further reduction of 9% going from 0.33 to 0.55 arcsec. Total reduction of 15% between 0.11 and 0.55 arcsec. ***Insignificant***.

Effect of detector pixel size on imaging performance



- Minimal resolvable distance changes from 0.5 to 0.55 arcsec going from ideal case to 0.33 arcsec pixels with dither. ***Insignificant***.

Point source sensitivity redux

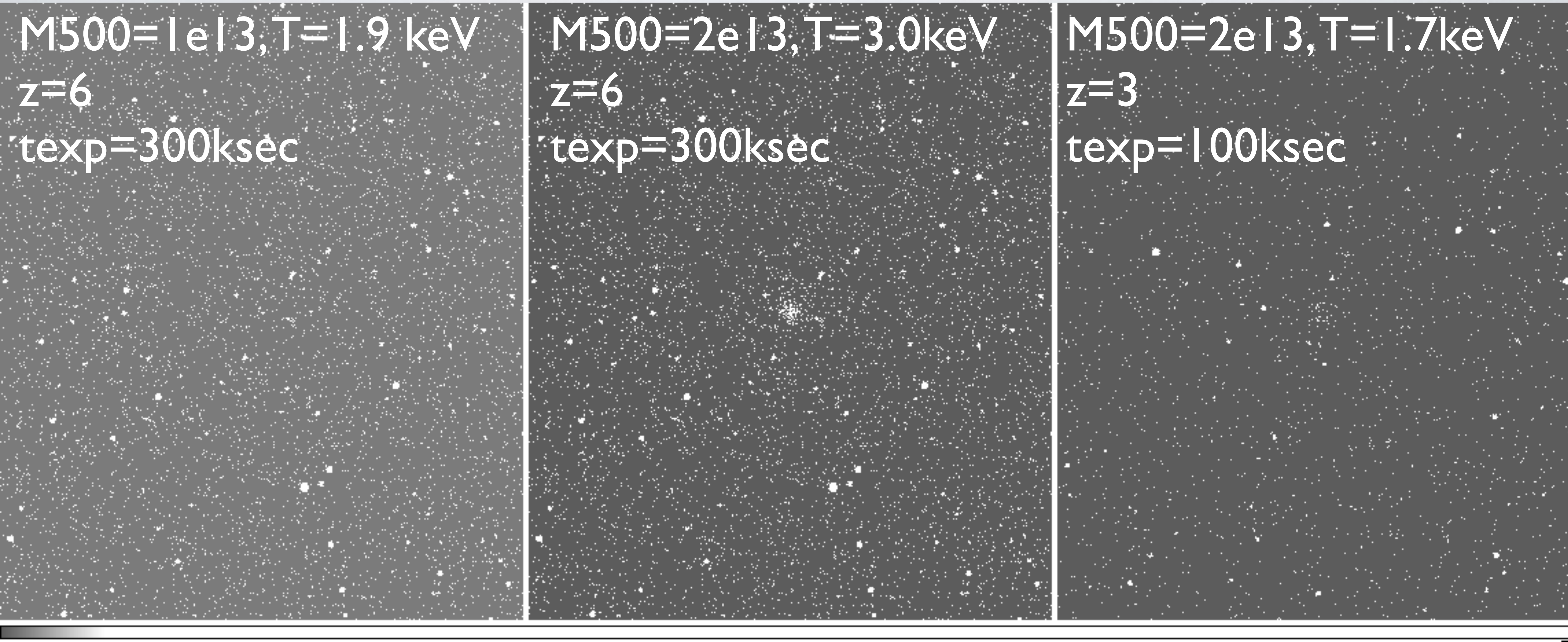
- Background effects (mostly due to Galactic diffuse emission) are non-neglibile in deep exposures (>1Msec). A 6x20 configuration is in the background-limited regime for exposures > 100 ksec.

- Effects of detector pixel size on the limiting sensitivity are negligible.

Point source sensitivity redux

	3x10	6x20
Detection threshold @ 4Msec (0.5-2 keV) (for known locations)	3.0×10^{-19} erg/s/cm^2 (1.1×10^{-19})	1.2×10^{-19} erg/s/cm^2 (5.3×10^{-20})
2–10 keV luminosity at z=10 assuming Γ=1.7	3.7×10^{41} erg/s (1.35×10^{41})	1.5×10^{41} erg/s (0.65×10^{41})
Bolometric luminosity at z=10, assuming 10% correction	3.7×10^{42} erg/s (1.35×10^{42})	1.5×10^{42} erg/s (0.65×10^{42})
Black Hole Mass assuming Eddington rate	29,000 Msun (11,000 Msun)	12,000 Msun (5,000 Msun)
For X-rays from star forming galaxies, assuming x10 higher Lx/SFR ratio at z=10 relative to local normalization	SFR=7.4 Msun/yr (2.7 Msun/yr)	3.0 Msun/yr (1.3 Msun/yr)

Cluster detection sensitivity



Clusters/Groups with M500 ~ 2e13 Msun (corresponds to T=0.7 keV at z=0) are detectable at z>3 in 100k+ exposures.

More sim's needed.